



Improved Charge-Transfer Fluorescent Dyes

These dyes are expected to be useful as molecular probes in diverse applications.

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Improved charge-transfer fluorescent dyes have been developed for use as molecular probes. These dyes are based on benzofuran nuclei with attached phenyl groups substituted with, variously, electron donors, electron acceptors, or combinations of donors and acceptors. Optionally, these dyes could be incorporated as parts of polymer backbones or as pendant groups or attached to certain surfaces via self-assembly-based methods.

These dyes exhibit high fluorescence quantum yields — ranging from 0.2 to 0.98, depending upon solvents and chemical structures. The wavelengths, quantum yields, intensities, and lifetimes of the fluorescence emitted by these dyes vary with (and, hence, can be used as indicators of) the polarities of solvents in which they are dissolved: In solvents of increasing polarity, fluorescence spectra shift to longer wavelengths, fluorescence quantum yields decrease, and fluorescence lifetimes increase. The wavelengths, quantum yields, intensities, and lifetimes are also

expected to be sensitive to viscosities and/or glass-transition temperatures.

Some chemical species — especially amines, amino acids, and metal ions — quench the fluorescence of these dyes, with consequent reductions in intensities, quantum yields, and lifetimes. As a result, the dyes can be used to detect these species.

Another useful characteristic of these dyes is a capability for both two-photon and one-photon absorption. Typically, these dyes absorb single photons in the ultraviolet region of the spectrum (wavelengths < 400 nm) and emit photons in the long-wavelength ultraviolet, visible, and, when dissolved in some solvents, near-infrared regions. In addition, these dyes can be excited by two-photon absorption at near-infrared wavelengths (600 to 800 nm) to produce fluorescence spectra identical to those obtained in response to excitation by single photons at half the corresponding wavelengths (300 to 400 nm).

While many prior fluorescent dyes exhibit high quantum yields, solvent-polar-

ity-dependent fluorescence behavior, susceptibility to quenching by certain chemical species, and/or two-photon fluorescence, none of them has the combination of all of these attributes. Because the present dyes do have all of these attributes, they have potential utility as molecular probes in a variety of applications. Examples include (1) monitoring curing and deterioration of polymers; (2) monitoring protein expression; (3) high-throughput screening of drugs; (4) monitoring such chemical species as glucose, amines, amino acids, and metal ions; and (5) photodynamic therapy of cancers and other diseases.

This work was done by Michael Meador of Glenn Research Center.

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17466-1.